1. $\boxed{15\text{: } [15, 29]}$

2. $221 = 13 \times 17$. $\boxed{17}$

3. $\sqrt{2^6 + 2^6 + 2^6 + 2^6} = \sqrt{4(2^6)} = \sqrt{2^2(2^6)} = \sqrt{2^8}$. We can write $\sqrt{x}$ as $x^{1/2}$, so we write $\sqrt{2^8}$ as $(2^8)^{1/2} = 2^4 = \boxed{16}$

4. $\boxed{90}$

5. $\boxed{8\text{: } [4,11]}$

6. $\boxed{90 \text{ m}}$

7. $8! = 1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 = 2 \cdot 3 \cdot (2^2) \cdot 5 \cdot (2 \cdot 3) \cdot 7 \cdot (2^3) = 2^7 \cdot 3^2 \cdot 5 \cdot 7$. So the largest square number we can factor out of 8! is $2^6 \cdot 3^2 = (2^3 \cdot 3)^2 = (8 \cdot 3)^2 = 24^2$. So $\boxed{N = 24}$

8. $10^n = 2^n \cdot 5^n$. 25! has several factors of 2. We just need to count how many factors of 5 are in 25!. The multiples of 5 less than or equal to 25 are 5, 10, 15, 20, and 25, and each of them has 1 factor of 5 except 25 which has 2. So there are 6 factors of 5 in 25!, so 10^6 will divide 25!. $\boxed{6}$

9. $\boxed{0}$

10. $\boxed{7}$